



# ARIZONA FOREST HEALTH CONDITIONS 2019

**A publication by the Forest Health Program of the Arizona  
Department of Forestry and Fire Management**

Arizona is a state with incredible landscape diversity that ranges from the lower Sonoran Desert scrub and pinyon-juniper woodland to the high elevation spruce-fir forests.

Forests cover roughly 27% of the state and occupy 19.4 million acres. These forests are comprised of 37 species of coniferous and hardwood trees. The majority of forestland is located above the Mogollon Rim with distinct forested areas scattered throughout the rest of the state. Juniper (*Juniperus* spp.) and pinyon juniper (*Pinus edulis-Juniperus* spp.) woodlands are the most abundant forest type in Arizona, occupying approximately 14.8 million acres, or 20.3% of the state. The rarest and most significant in ecological terms is riparian forest, which occupies less than one-half of 1% of Arizona's land.

In urban areas, we experience urban forests that are typically composed

**13.4 million acres  
surveyed by air**

---

**459,000 acres of tree  
damage from bark  
beetles**

---

**66% increase in  
bark beetle activity**

---

**34,000 acres of tree  
damage from foliar  
blight**

of a mix of native and introduced tree species that require various management techniques. These urban forests are inhabited by almost 90% of Arizona's residents and provide numerous environmental, economic and social benefits. With such a broad diversity of forests comes a similarly diverse group of insects and diseases that impact forest and woodland health, such as pine engraver beetles, pine sawflies, spruce aphid, pinyon needle scale, sycamore anthracnose, and white pine blister rust.

Annually, the Department of Forestry and Fire Management (DFFM) partners with the USDA Forest Service to survey millions of acres of forest and woodland resources from the air. The Aerial Detection Survey (ADS) provides land managers and the public with information about landscape-level forest and woodland health conditions (Fig. 1). In 2019, the ADS occurred over 13 million acres to detect dead and/or dying trees. During the year, DFFM forest health specialists and district staff verify ADS data, conduct ground surveys, and provide landowner technical assistance. This conditions report summarizes the ADS and discusses forest and woodland health issues in Arizona.

## Overview

The most significant event detected in 2019 was an increase of bark beetle-caused tree mortality on Indian Lands, where a total of 352,696 acres were affected. This damage was occurring in pinyon pine forests on Navajo and Hopi lands. Foliar blight (*Marssonina populi*) also caused significant defoliation across northern Arizona and we experienced a large increase of Mediterranean Pine Engraver (*Orthotomicus erosus*) in the northeast Phoenix metropolitan area. Compared to the spring and summer of 2018, precipitation was higher in the summer of 2019. Maricopa County experienced record rainfall in October 2018 followed by above average precipitation in parts of northern Arizona. However, a below average monsoon season from June through September 2019 has shown some negative impacts on vegetation statewide. Forest trees are dependent on adequate soil moisture in the spring for the production of their defensive chemicals and structures to protect them from harmful insects and diseases. Under drought conditions, most trees are in a state of extreme stress and highly vulnerable to bark beetles, especially in areas that are experiencing exceptional drought. Drought conditions in May 2019 were far better than in May 2018 (Fig. 2). However, the residual bark beetle population from extreme drought conditions in 2018 still led to an increase in bark beetle populations in 2019.

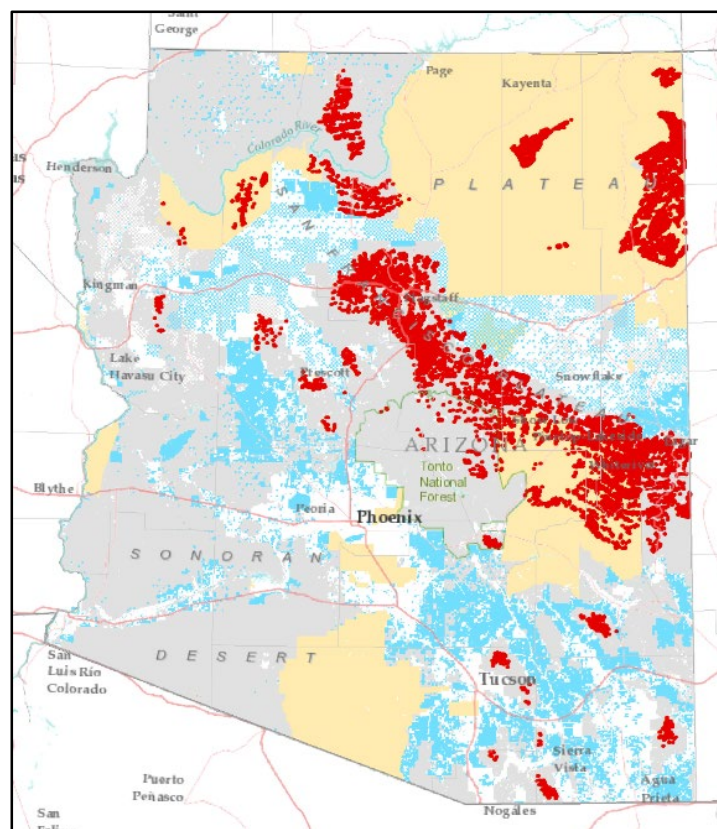


Figure 1. Arizona 2019 Aerial Detection Survey Insect and Disease Locations

# Drought Comparison for May 2018/19

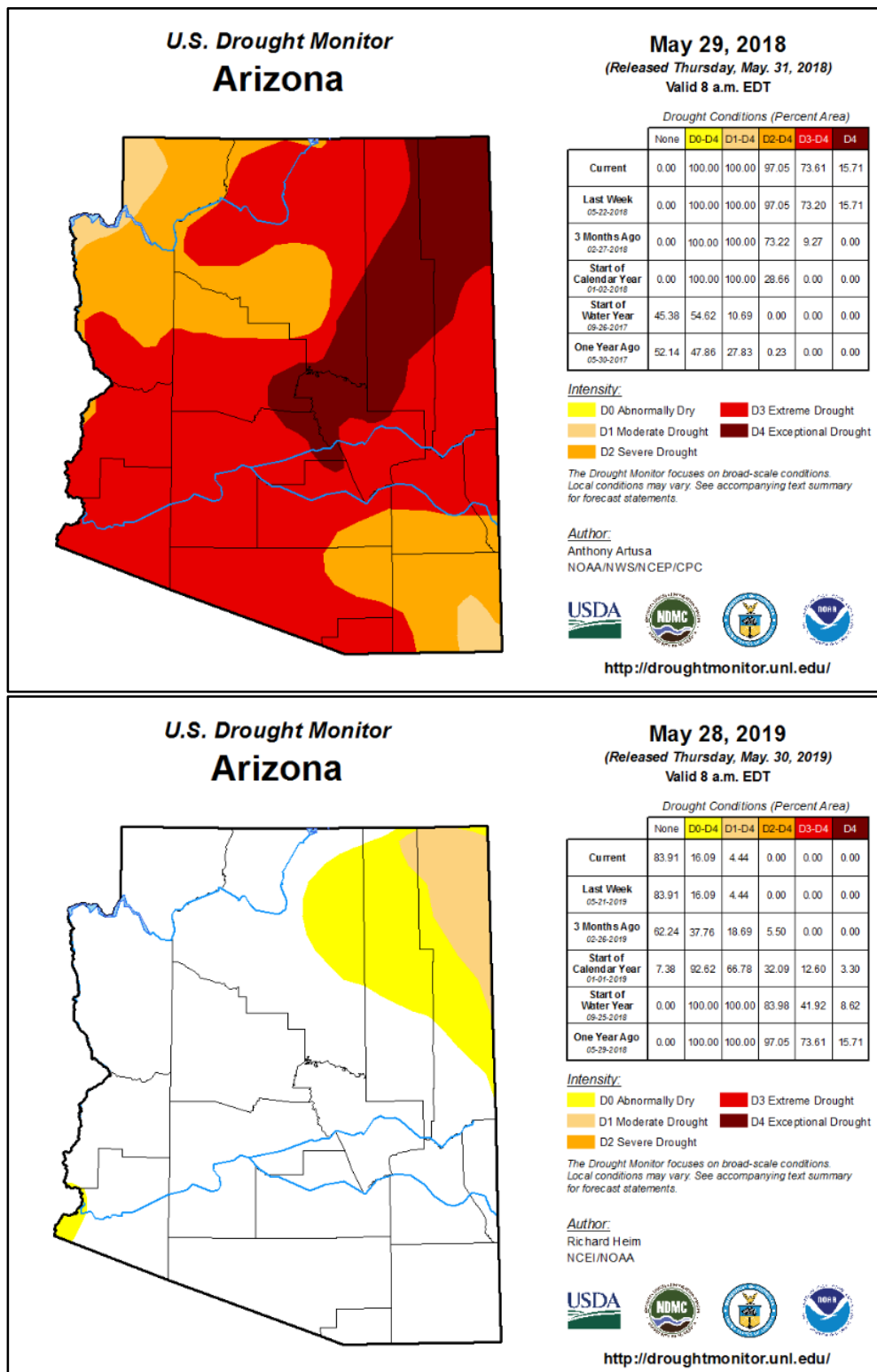


Figure 2. Drought Comparison of May 2018 and May 2019



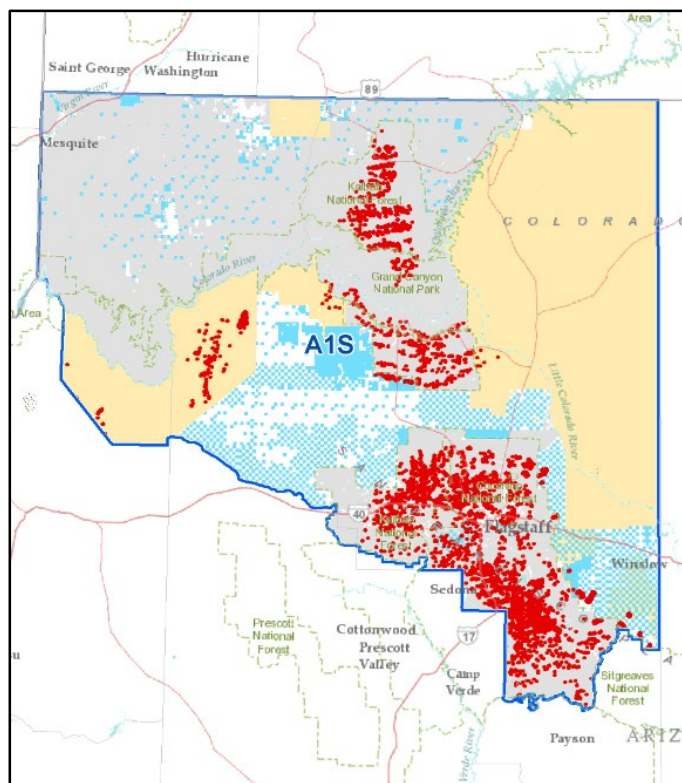
Arizona Department of Forestry and Fire Management has 5 distinct districts. Each district shares similar forest and woodland health issues while experiencing a varying degree of tree damage from insects and disease.

## Northern District (A1S)

There was a total of 41,993 acres of forest trees impacted by insects and disease in 2019 in the Northern District, which is a decrease of 38% over the previous year. Most of this decrease was due to improved forest health conditions from above average precipitation in winter 2018-19.

*Table 1. Northern District (A1S) Estimated Acres of Observed Tree Damage by Land Ownership (Acres)*

Damage Causing Agent	Federal	Indian Lands	Private	State and Local	Grand Total
Abiotic Agents	0.3				0.3
Bark Beetles	22,395.1	3,681.2	3,957.3	3,748.0	33,781.6
Defoliators	5,728.1				5,728.1
Foliage and Shoot Diseases	1,735.7		164.1		1,899.8
Human Activities (roads salt, deicer)	87.5		5.7		93.2
Sap Feeders	0.5	38.4			38.9
Unknown	197.9	210.6	40.0	3.2	451.7
<b>Grand Total</b>	<b>30,145.1</b>	<b>3,930.1</b>	<b>4,167.1</b>	<b>3,751.2</b>	<b>41,993.4</b>



*Photo Credit: Daniel DePinte, USFS*



*Figure 4. Location of Insect and Disease Activity in the Northern District.*

# Northeast District (A2S)

There was a total of 453,366 acres of forest trees impacted by insects and disease in 2019 in the Northeast District, which is an increase of 141% over the previous year. Most of this increase was due to bark beetle activity in pinyon pine on Navajo and Hopi lands which affected 345,033 acres. Black leaf spot (*Marssonina populi*) defoliated approximately 33,000 acres of aspen. This foliar blight is native to northern Arizona and was a response to high spring precipitation.

Table 2. Northeast District Estimated Acres of Observed Tree Damage by Land Ownership (Acres)

Damage Causing Agent	Federal	Indian Lands	Private	State and Local	Grand Total
Bark Beetles	63,811.4	345,033.2	1,126.3	440.1	410,411.0
Declines	1.0				1.0
Defoliators	736.7	329.8			1,066.5
Foliage and Shoot Diseases	7,029.6	25,679.4	7.4		32,716.3
Sap Feeders	964.8	7,804.0			8,768.8
Unknown	21.4	379.7	1.4		402.5
<b>Grand Total</b>	<b>72,565.0</b>	<b>379,226.2</b>	<b>1,135.0</b>	<b>440.1</b>	<b>453,366.2</b>

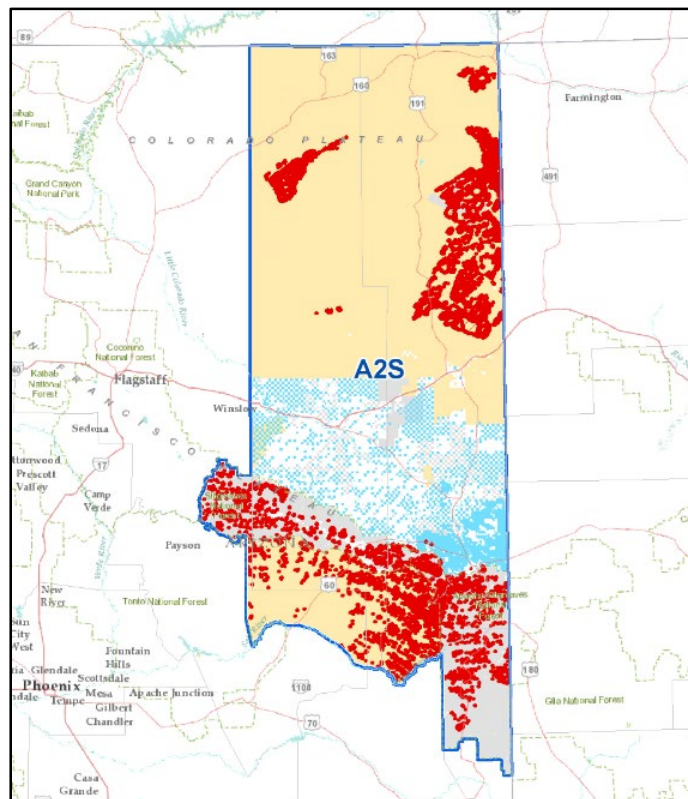


Photo Credit: Daniel DePinte, USFS



Figure 5. Location of Insect and Disease Activity in the Northeast District.



# Southeast District (A3S)

There was a 6% increase in insect and disease impacts to trees in the Southeast District in 2019 compared to the previous year. Bark Beetle activity on private land increased from 22 to 66 acres and decreased from 37 acres to <1 acre on state land. Trapping of bark beetles has continued in numerous parks throughout Tucson in 2019. *Ips calligraphus* is being recorded in traps with a total trap catch of 6,717 beetles. A single specimen of *Ips lecontei* was present in one trap during the duration of the project.

Table 3. Southeast District Estimated Acres of Observed Tree Damage by Land Ownership

Damage Causing Agent	Federal	Indian Lands	Private	State and Local	Grand Total
Bark Beetles	8,073.1		66.3	0.3	8,139.7
Defoliators	32.1				32.1
Wood Borers	63.1				63.1
Grand Total	8,168.2	0.0	66.3	0.3	8,234.8

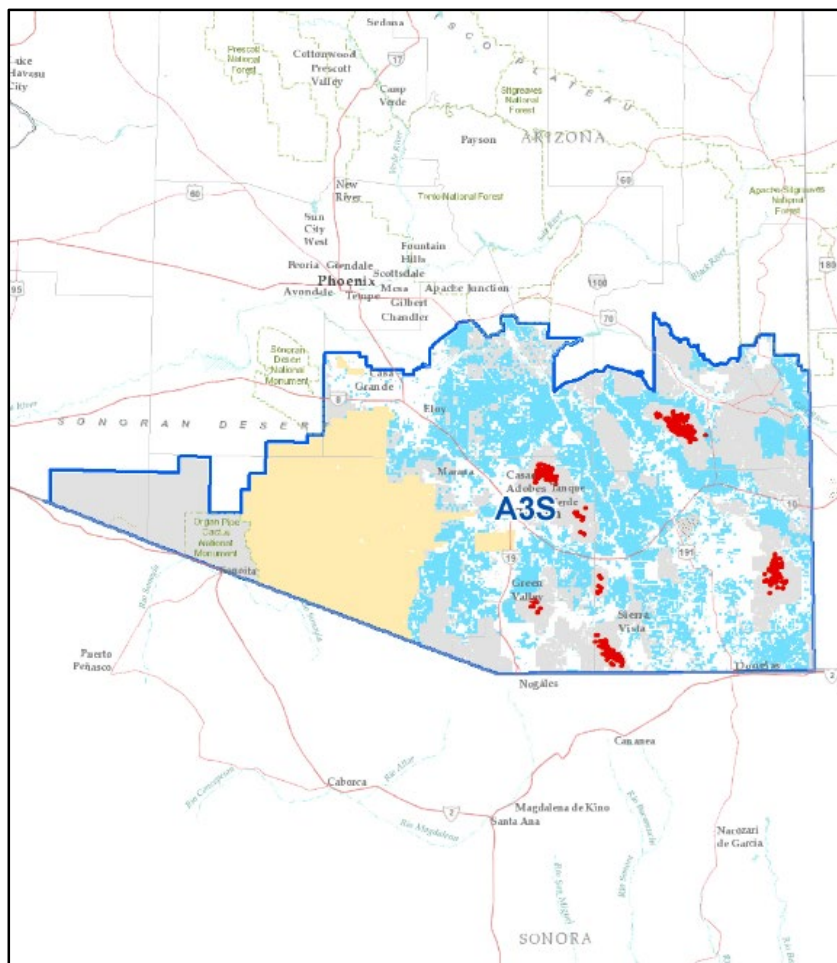


Photo Credit: Aaron Casem, DFFM



Figure 6. Location of Insect and Disease Activity in the Southeast District.

# Central District (A4S)

There was an 87% decrease in insect and disease impacts to trees in the Central District in 2019 with 6,693 acres being affected. Most of the impacts were caused by bark beetles, primarily in ponderosa pine forests. Aleppo pine blight (APB) also occurred at lower levels in 2019 in the Phoenix metropolitan area. However, we are still within the window for symptoms to appear as APB can occur through January.

Table 4. Central District Estimated Acres of Observed Tree Damage by Land Ownership

Damage Causing Agent	Federal	Indian Lands	Private	State and Local	Grand Total
Bark Beetles	2,536.6		3,981.2	13.0	6,530.8
Defoliators	158.1				158.1
Foliage and Shoot Diseases	4.6				4.6
Grand Total	2,699.2	0.0	3,981.2	13.0	6,693.4

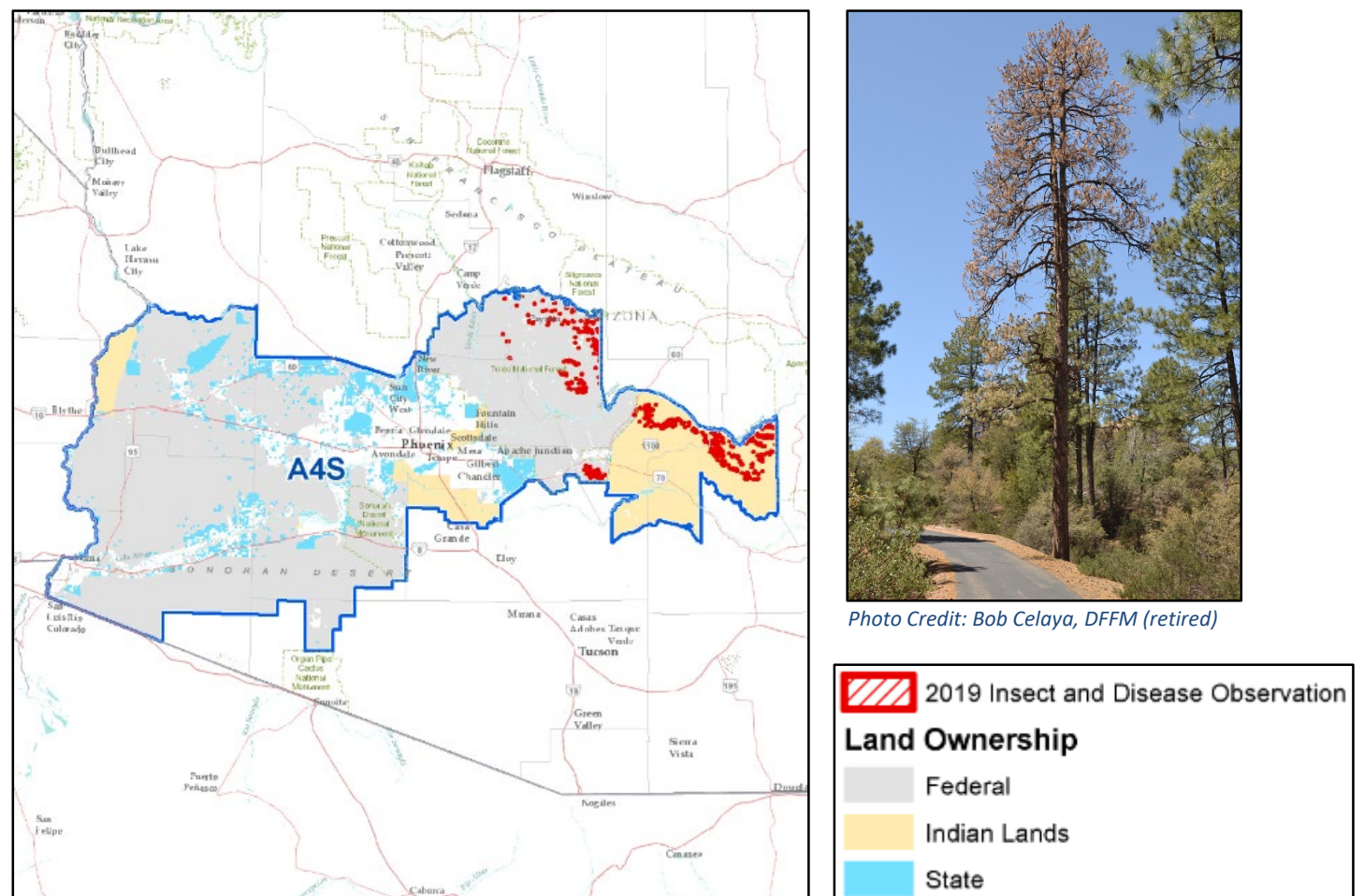


Figure 7. Location of Insect and Disease Activity in the Central District



# Northwest District (A5S)

There was an 85% decrease in insect and disease impacts to trees in the Northwest District in 2018 compared to the previous year. Bark beetle damage is the biggest concern on private land in the NW District and western pine beetle is still infesting ponderosa pine in the Hualapai Mountains.

Table 5. Northwest District Estimated Acres of Observed Tree Damage by Land Ownership

Damage Causing Agent	Federal	Indian Lands	Private	State and Local	Grand Total
Bark Beetles	355.8		17.3	2.3	375.4
Sap Feeders	230.3		63.3	11.4	305.1
Unknown	92.2		16.0		108.2
<b>Grand Total</b>	<b>678.3</b>	<b>0.0</b>	<b>96.6</b>	<b>13.7</b>	<b>788.7</b>

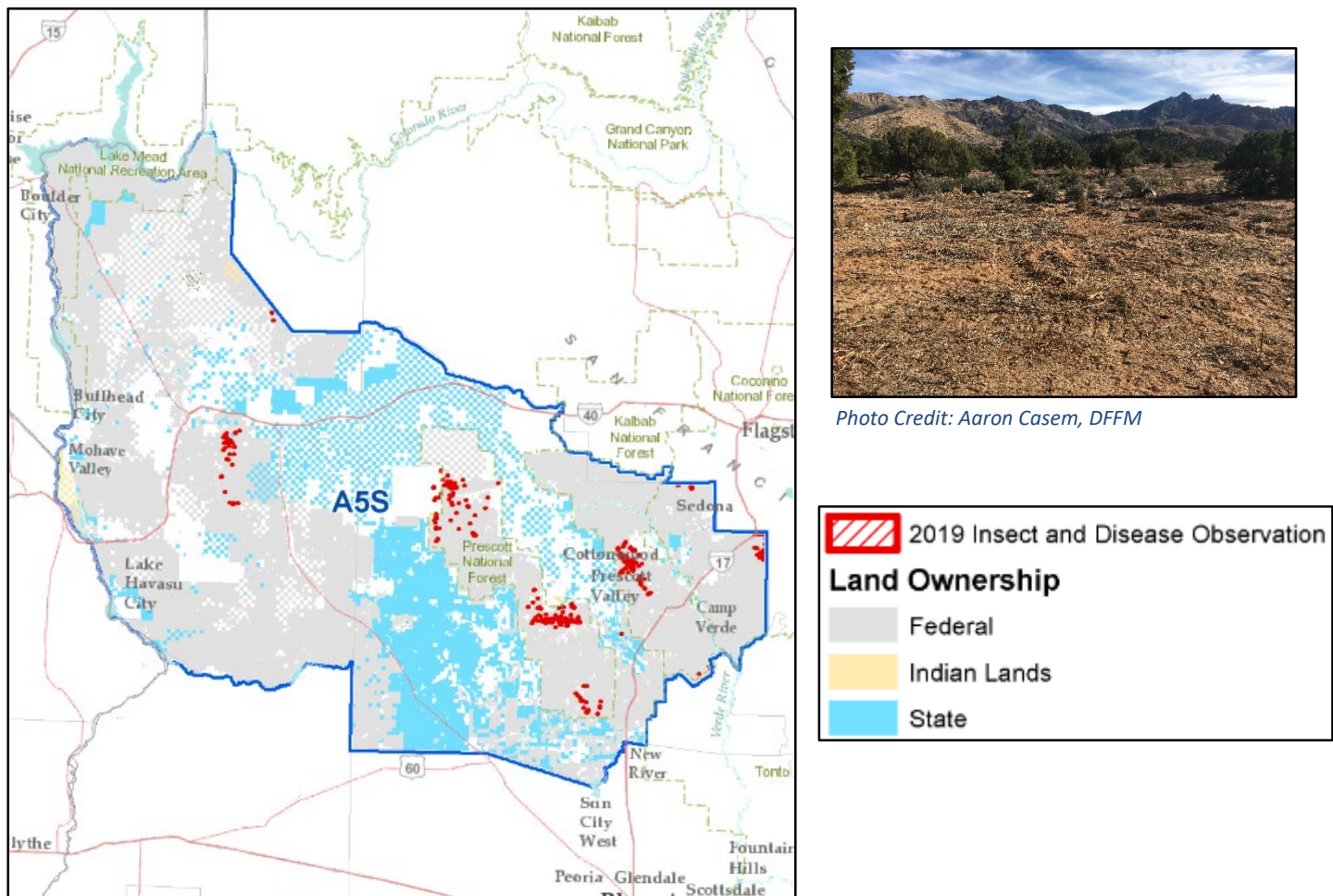


Figure 8. Location of Insect and Disease Activity in the Northwest District



Photo Credit: Aaron Casem, DFFM



# Statewide Insect and Disease Update

## Bark Beetles

In Arizona, there are several bark beetle species that cause ponderosa pine mortality, therefore they are grouped in this report as the ponderosa pine bark beetle complex. The main species that attack ponderosa pine in Arizona are western pine beetle (*Dendroctonus brevicomis*), roundheaded pine beetle (*D. adjunctus*), Arizona five-spined Ips (*Ips lecontei*), and the pine engraver (*I. pini*). The Mexican pine beetle (*D. approximatus*), southern pine beetle (*D. frontalis*), six-spined Ips (*I. calligraphus*), and *I. kanusi* also contribute to ponderosa pine mortality, but are less abundant. There were 161,774 acres of ponderosa pine damage attributed to bark beetles in 2019, with the majority occurring along vegetation transition zones along the Mogollon Rim.

### Western Pine Beetle

The western pine beetle is found throughout the range of ponderosa pine, its principle host, except in the Black Hills of South Dakota. Outbreaks of this beetle can cause extensive tree mortality. In the southern Sierra Nevada of California during a recent outbreak in 2015-16, 100% mortality of some stands were observed (Fig. 9). These beetles typically emerge from infested trees around the middle of April and can have up to 3 generations per year. They prefer mature ponderosa pine except during periods of outbreak where trees as small as 6 inches in diameter at breast height (dbh) are attacked. They typically prefer the lower and mid-bole of the tree, and are often found in association with Ips beetles (which attack the upper bole) as well as the red turpentine beetle (*D. valens*) (which attack the trunk near the ground).



Figure 9. Western pine beetle-caused tree mortality in California in 2016. Photo Credit: USFS

### Roundheaded Pine Beetle

The roundheaded pine beetle is found only in the southwestern range of ponderosa pine and produces just one generation per year. What is unique about this beetle is that it emerges in mid-fall in search of a new host. The female initiates the attack and will construct a vertical gallery that is somewhat sinuous, which makes it easy to identify (Fig. 10).



Figure 10. Roundheaded pine beetle galleries. Photo Credit: USFS

## Ips spp.

There are several species of Ips beetles that attack ponderosa pine in Arizona, but the two that cause the most mortality are the Arizona five-spined Ips and the pine engraver. These two bark beetles are very similar in behavior, except that the Arizona five-spined Ips is found only in Arizona and New Mexico, while the pine engraver is found throughout the range of ponderosa pine and also uses other pine species as hosts. The male Ips beetle initiates the attack and creates a nuptial chamber where it mates with typically 3 or 4 females (Fig. 11). Like the western pine beetle, Ips beetles can have 3 generations per year and have the capacity to cause widespread mortality during periods of drought.



Figure 11. *Ips calligraphus* galleries. Photo Credit: Bob Celaya, DFFM (retired)



Figure 12. Pinyon Ips mortality. Photo Credit: Bob Celaya, DFFM (retired)

## Pinyon Ips

Pinyon pine had the greatest increase in bark beetle damage in 2019 with 231,755 acres affected. Most of this damage occurred on Hopi and Navajo Tribal lands. The pinyon Ips biology is similar to those that attack ponderosa pine, with the exception that adult pinyon Ips spend the fall and winter feeding at the base of the tree. Like other Ips species, pinyon Ips can have up to 3 generations per year, therefore populations can exponentially increase during periods of extreme drought (Fig. 12).

## Cedar Bark Beetle

The cedar bark beetle (*Phloeosinus* spp.), in association with drought, affected 42,026 acres of juniper in 2019. The hosts for cedar bark beetle are juniper species and Arizona cypress (*Cupressus arizonica*). Typically, these bark beetles are uncommon and rarely found except during periods of extreme and exceptional drought when they can cause widespread mortality as was mentioned in the Forest Service Region 3 Forest Conditions Report during the drought of 2002-2003.



Figure 13. Cedar bark beetle galleries near Prescott, AZ. Photo Credit: Steve McKelvey, DFFM



# Forest Health in Urban Areas

The Aleppo pine blight (APB), a recurring but sporadic issue in the southwest, had minimal activity in the Phoenix metropolitan area during 2019. While there has continued to be much speculation, no definitive cause has been identified for APB. In an effort to identify the causal agent behind the blight, monitoring efforts were conducted by DFFM staff in December 2018 and January 2019 at locations throughout the valley where blight had previously been observed or was currently being observed. Trees were inventoried taking into consideration species and dbh, and were photographed and rated based on the degree of blight impacting the crown. Additionally, needle samples were removed using an extendable pole pruner and examined for mites. The data were compiled using the Survey123 ArcGIS application. In general, trees that were exhibiting blight symptoms had the pine feeding mite (*Oligonychus milleri*) present at varying levels; however, there were some instances where trees were not showing signs of blight but were heavily infested with mites. Our data suggest further investigation is needed to confirm the causal agent(s) of the Aleppo pine blight.



Figure 16. Sampling Aleppo pine blight in the Phoenix metropolitan area.  
Photo Credit: John Richardson, DFFM

The Mediterranean pine engraver (*Orthotomicus erosus*) or MPE, was first discovered in the Central Valley of California in 2004. This non-native bark beetle has steadily spread to other regions in the southwest.

In 2018, monitoring traps were established in the Phoenix metropolitan area to determine if the bark beetle was present. Two of five traps locations had positive results. In total, 337 beetles were trapped in 2018 (332 - Roadrunner Park; 5 - Comanche Park). In December 2018, live MPE were detected in dead Eldarica pines (*Pinus eldarica*) just a few miles away from Roadrunner Park. In an effort to better understand the population and distribution of MPE in the valley, a total of 16 traps were placed in the northeast Phoenix and west Scottsdale areas. Traps were collected every week for twenty weeks starting in April 2019 and ending in August 2019. Samples from this collection period are still being processed but to date 45,424 MPE have been counted. An interactive dashboard has been created to update our partners on our trap locations and MPE tallies which can be viewed here:

<https://dffm.maps.arcgis.com/apps/opsdashboard/index.html#/155a5caaf94e4d8c82b42d24a7498451>

In Tucson, the Urban Forest Health trapping project concluded in September 2019 with a total of 6,717 bark beetles collected between 2017 and 2019. Udall and Reid Park had the most trap catches throughout the project. All but one bark beetle was identified as *Ips calligraphus*. The one bark beetle anomaly was identified as *Ips lecontei* and was trapped at Udall Park. The third species of interest, the Mediterranean Pine Engraver, was not present in any of the lured traps.



# Flight Information

Table 6. Estimated Flight Area by Forest Type

Forest Type	Arizona (ac)	Flight Area (ac)	Covered by Flight (%)
Forest	5,847,239	4,937,844	84.4%
PJ Woodland	10,205,097	5,240,268	51.3%
Woodland	3,223,490	513,965	15.9%
Other	53,656,586	2,738,075	5.1%
<b>Total Area</b>	<b>72,932,412</b>	<b>13,430,152</b>	<b>18.4%</b>

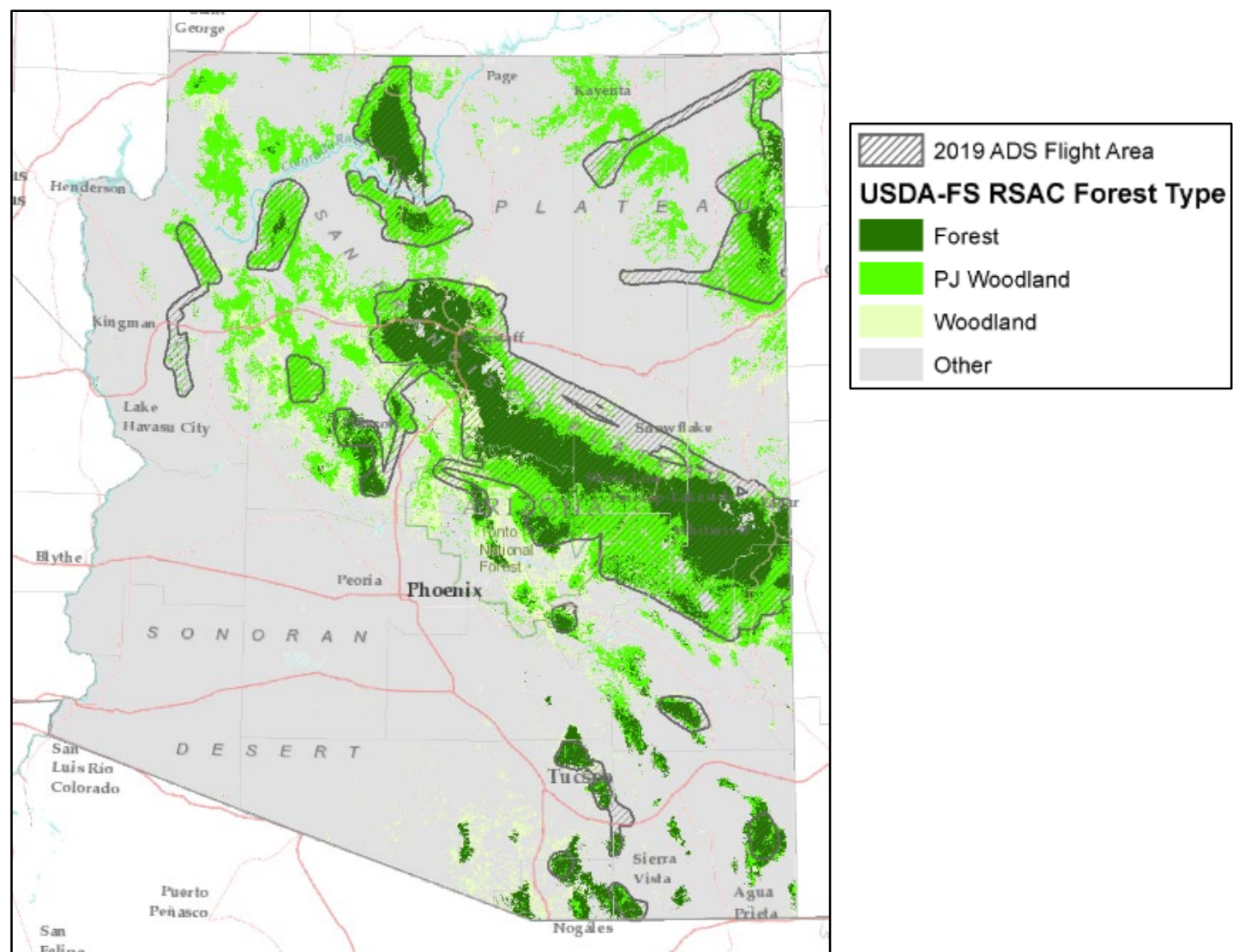


Figure 19. 2019 Aerial Detection Survey Flight Area

# Contact Information

The DFFM Forest Health Program is a statewide program that is based in Phoenix, AZ.

Office of the State Forester  
1110 West Washington St., Suite 100  
Phoenix, Arizona 85007  
602-771-1400

Website: [dffm.az.gov](http://dffm.az.gov)

Forest Health Website: [dffm.az.gov/forestry-community-forestry/forest-health](http://dffm.az.gov/forestry-community-forestry/forest-health)

---

## The Forest Health Team

**Forestry Programs Administrator:** John Richardson, [JRichardson@dffm.az.gov](mailto:JRichardson@dffm.az.gov), 602-771-1420

**Forest Health Program Manager:** Cori Dolan, [Cdolan@dffm.az.gov](mailto:Cdolan@dffm.az.gov), 520-262-5519

**Project Coordinator:** Wolfgang Grunberg, [WGrunberg@dffm.az.gov](mailto:WGrunberg@dffm.az.gov), 602-399-1886

**Urban Forestry Specialist:** Jon Orona [JOrona@dffm.az.gov](mailto:JOrona@dffm.az.gov), 602-771-1407

---

*The State of Arizona Forest Health Program is made possible with assistance from the USDA Forest Service.*

*In accordance with Federal law and U.S. Department of Agriculture policy, this institution is prohibited from discriminating on the basis of race, color, national origin, sex, age, or disability. (Not all prohibited bases apply to all programs.)*



*Photo Credit: Bob Celaya, DFFM (retired)*



Published: December 20, 2019